L Number	Hits	Search Text	DB	Time stamp
-	12315	"lead frame"	USPAT; US-PGPUB	2003/09/22 14:37
-	48228	die and adhesive	USPAT; US-PGPUB	2003/09/22 14:38
-	4235	"plastic casing" or (plastic with encapsulation)	USPAT; US-PGPUB	2003/09/22 14:38
-	274	"lead frame" and (die and adhesive) and ("plastic casing" or (plastic with encapsulation))	USPAT; US-PGPUB	2003/09/22 14:21
-	395	438/112.ccls.	USPAT; US-PGPUB	2003/09/22 14:25
-	1240523	@ad>19970211 or @rlad>19970211	USPAT; US-PGPUB	2003/09/22 14:22
-	11	("lead frame" and (die and adhesive) and ("plastic casing" or (plastic with encapsulation))) and 438/112.ccls.	USPAT; US-PGPUB	2003/09/22 14:22
-	3	(("lead frame" and (die and adhesive) and ("plastic casing" or (plastic with encapsulation))) and 438/112.ccls.) not (@ad>19970211 or @rlad>19970211)	USPAT; US-PGPUB	2003/09/22 14:22
-	7939	"lead frame" and leads	USPAT; US-PGPUB	2003/09/22 14:23
-	3	((("lead frame" and (die and adhesive) and ("plastic casing" or (plastic with encapsulation))) and 438/112.ccls.) not (@ad>19970211 or @rlad>19970211)) and ("lead frame" and leads)	USPAT; US-PGPUB	2003/09/22 14:23
-	1032	438/118.ccls.	USPAT; US-PGPUB	2003/09/22 14:31
-	20	("lead frame" and (die and adhesive) and ("plastic casing" or (plastic with encapsulation))) and 438/118.ccls.	USPAT; US-PGPUB	2003/09/22 14:25
-	13	(("lead frame" and (die and adhesive) and ("plastic casing" or (plastic with encapsulation))) and 438/118.ccls.) not (@ad>19970211 or @rlad>19970211)	USPAT; US-PGPUB	2003/09/22 14:26
-	11	("lead frame" and leads) and ((("lead frame" and (die and adhesive) and ("plastic casing" or (plastic with encapsulation))) and 438/118.ccls.) not (@ad>19970211 or @rlad>19970211))	USPAT; US-PGPUB	2003/09/22 14:26
-	508	438/122.ccls.	USPAT; US-PGPUB	2003/09/22 14:33
-	9	("lead frame" and (die and adhesive) and ("plastic casing" or (plastic with encapsulation))) and ("lead frame" and leads) and 438/122.ccls.	USPAT; US-PGPUB	2003/09/22 14:32
-	4	(("lead frame" and (die and adhesive) and ("plastic casing" or (plastic with encapsulation))) and ("lead frame" and leads) and 438/122.ccls.) not (@ad>19970211 or @rlad>19970211)	USPAT; US-PGPUB	2003/09/22 14:32
-	906	438/123.ccls.	USPAT; US-PGPUB	2003/09/22 14:36
-	38	("lead frame" and (die and adhesive) and ("plastic casing" or (plastic with encapsulation))) and ("lead frame" and leads) and 438/123.ccls.	USPAT; US-PGPUB	2003/09/22 14:36
-	17	(("lead frame" and (die and adhesive) and ("plastic casing" or (plastic with encapsulation))) and ("lead frame" and leads) and 438/123.ccls.) not (@ad>19970211 or @rlad>19970211)	USPAT; US-PGPUB	2003/09/22 14:33
-	700	438/125.ccls.	USPAT; US-PGPUB	2003/09/22 14:36
-	5	("lead frame" and (die and adhesive) and ("plastic casing" or (plastic with encapsulation))) and ("lead frame" and leads) and 438/125.ccls.	USPAT; US-PGPUB	2003/09/22 14:36
-	0	(("lead frame" and (die and adhesive) and ("plastic casing" or (plastic with encapsulation))) and ("lead frame" and leads) and 438/125.ccls.) not (@ad>19970211 or @rlad>19970211)	USPAT; US-PGPUB	2003/09/22 14:36
-	657	438/126.ccls.	USPAT; US-PGPUB	2003/09/22 14:36
-	7	("lead frame" and (die and adhesive) and ("plastic casing" or (plastic with encapsulation))) and ("lead frame" and leads) and 438/126.ccls.	USPAT; US-PGPUB	2003/09/22 14:37

-	0	(("lead frame" and (die and adhesive) and ("plastic casing" or (plastic with encapsulation))) and ("lead frame" and leads) and 438/126.ccls.) not (@ad>19970211 or @rlad>19970211)	USPAT; US-PGPUB	2003/09/22 14:37
-	228	438/for.413.ccls.	EPO; JPO; DERWENT	2003/09/22 14:37
-	39243	"lead frame"	EPO; JPO; DERWENT	2003/09/22 14:37
-	7361	die and adhesive	EPO; JPO; DERWENT	2003/09/22 14:38
-	1546	"plastic casing" or (plastic with encapsulation)	EPO; JPO; DERWENT	2003/09/22 14:38
-	0	438/for.413.ccls. and "lead frame" and (die and adhesive) and ("plastic casing" or (plastic with encapsulation))	EPO; JPO; DERWENT	2003/09/22 14:39
-	16	438/for.413.ccls. and "lead frame"	EPO; JPO; DERWENT	2003/09/22 14:38
-	8	"lead frame" and (die and adhesive) and ("plastic casing" or (plastic with encapsulation))	EPO; JPO; DERWENT	2003/09/22 14:39

What is claimed is:

1. A method for producing an electrical device comprising the steps of:

forming a flat lead frame including a plurality of leads extending radially from a central opening, the lead frame having opposing upper and lower surfaces;

mounting the lead frame and an integrated circuit die onto a strip of adhesive tape such that a lower surface of the die contacts the adhesive tape and the die is located in the central opening, and the lower surface of the lead frame also contacts the adhesive tape;

forming a plastic casing over an upper surface of the die and the upper surface of the lead frame; and

removing the adhesive tape to expose the lower surfaces of the die and the lead frame.

2. The method according to claim 1, wherein the die includes a plurality of die bond pads, and the method further comprises the step of electrically connecting each of the die bond pads to a selected one of the plurality of leads.

3. The method of claim 2, wherein the step of electrically connecting comprises wire bonding.

4. The method of claim 1, wherein the step of forming the lead frame comprises etching a metal sheet.

5. The method of claim 1, wherein the step of forming the lead frame comprises stamping a metal sheet.

6. The method of claim 1, wherein the step of forming the plastic casing comprises molding plastic onto the upper surfaces of the die and the lead frame.

s spaced from the free ends 116 of the leads 115. The die 20 includes an upper (first) surface 122 and a lower bond) surface 124, and also includes a plurality of die nd pads 126 located on the upper surface 124. The die nd pads 126 are electrically connected to the integrated rcuit (not shown) which is fabricated on the die 120, and e also electrically connected to the upper surfaces 112 of ected leads 115 via wires 130 using known wire bond chniques. A plastic casing 160 is formed over lead frame 0, die 120 and wires 130 for protection.

In accordance with a first aspect of the present invention, e lower surfaces 114 and 124 are exposed through the astic casing 160, thereby facilitating rapid heat dissipation om the die 120, and thereby enhancing thermal perfor- nce of the electronic device 100. In particular, when the ectronic device 100 is mounted on a circuit board in a wity up" arrangement (i.e., such that the lower surfaces 4 and 124 face a surface of the circuit board), the die 120 n be mounted directly onto a heat sink formed on the rcuit board. The direct contact between the die 120 and the at sink provides significantly better heat dissipation over st of the known enclosed-die package shown in FIG. 1 of e present application. The electronic device 100 can also beneficially used in a "cavity down" arrangement (i.e., ch that the lower surfaces 114 and 124 face away from the inted board) by providing suitable ventilation and/or a heat nk structure mounted directly onto the die 120.

In accordance with a second aspect of the present vention, the lower surface 114 of the lead frame 110 is -planar with a lower surface 124 of the die 120. This rangement yields a very low-profile package when com- red with the known enclosed-die package shown in FIG. of the present application.

FIGS. 2-6 show a method for producing an electronic vice using the plastic package formed in accordance with e present invention.

Referring to FIGS. 2A and 2B, the lead frame 110 is rmed from a thin metal (e.g., copper) strip which has been ched or stamped to form a pattern similar to that shown in G. 2A. The upper (first) surface 112 and the opposing wer (second) surface 114 are indicated in FIG. 2B. Each of e radial leads 115 has a free end 116 and a fixed end 117. e free ends 116 of the plurality of leads 115 surround and fine the central opening 118. The fixed ends 117 of the ads 115 are connected to a skirt 119, which is removed er the plastic casing 160 is formed, as described below. It noted that the lead frame 110 shown in FIG. 2A is mplified for clarity. A lead frame 110 used in an actual ckage may have a different shape than that shown in FIG. , and typically includes many more leads 115.

Referring to FIG. 3, the lead frame 110 is mounted on an hesive tape 170 such as polyimide with an adhesive layer. e purpose of the adhesive tape 170 is to support the die 0 and lead frame 110 during the assembly process, and to intain the die 120 in a proper location relative to the lead me 110. Specifically, the lower surface 114 of the lead me 110 contacts a sticky surface 172 of the adhesive tape 0, and the upper surface 112 of the lead frame faces away om the adhesive tape 170. A central portion 174 of the hesive tape 170 remains exposed through the central ening 118 of the lead frame 110.

Referring to FIG. 4, the die 120 is then mounted on the central portion 174 of the adhesive tape 170. Specifically, the die 120 is positioned in the central opening 118 such that the lower surface 124 of the die 120 contacts the sticky surface 172 of the adhesive tape 170, and the upper surface 122 of the die 120 faces away from the adhesive tape 170. The sticky surface 174 supports the lead frame 110 and the die 120 such that the lower surfaces 114 and 124 are co-planar.

Referring to FIG. 5, wires 130 are then connected between the die bond pads 126 and the leads 115 using known wire bond techniques.

Referring to FIG. 6, the molded plastic casing 160 is then formed over lead frame 110, die 120 and wires 130 using known plastic molding methods (such as transfer molding) while the lead frame 110 and die 120 remain mounted on the adhesive tape 170. During the molding process, liquified molding material flows onto exposed portions of the adhesive tape 170 which are located between the die 120 and the free ends 116 of the lead frame, and between the leads 115. This molding material solidifies to form intervening portions 162 which serve to maintain the relative positions of the die 120 and leads 115. After encapsulation, skirt 118 is removed by trimming.

Finally, as shown in FIG. 7, the adhesive tape 170 is removed from the die 120 and the lead frame 110, thereby exposing the lower surface 124 of the die 120, the lower surface 114 of the lead frame 110, and lower surfaces 164 of the intervening portions 162, all of which being co-planar.

The device 100 shown in FIG. 7 can be attached to a circuit board using several possible methods. For example, a BGA package format may be obtained by trimming the leads 115 such that they are flush with a side surface 166 of the plastic casing 160, and attaching solder balls or columns to the lower surfaces 114 of the leads 115. Alternatively, the skirt 119 can removed by cutting the leads 115 near the fixed ends 117, and then bending the leads to provide contact with a circuit board.

While particular embodiments of the present invention have been shown and described, it will be obvious to those skilled in the art that changes and modifications may be made without departing from this invention in its broader aspects. For example, the lead frame may have any known configuration, and is not intended to be limited to the construction of lead frame 110 shown in FIGS. 2A and 2B. Further, the steps of mounting the die 120 and lead frame 110 onto the adhesive tape 170 shown in FIGS. 3 and 4 may be reversed. Moreover, glob top material may be used in place of the molded plastic casing 160. Therefore, the appended claims are to encompass within their scope all such changes and modifications as fall within the true spirit and scope of this invention.

What is claimed is:

1. A method for producing an electrical device comprising the steps of:

forming a flat lead frame including a plurality of leads extending radially from a central opening, the lead frame having opposing upper and lower surfaces;

mounting the lead frame and an integrated circuit die onto a strip of adhesive tape such that a lower surface of the die contacts the adhesive tape and the die is located in the central opening, and the lower surface of the lead frame also contacts the adhesive tape;